SATA CONTROLLER INTO A SPACE CPU

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Abstract

The presentation is dedicated to the project "SATA Controller into a Space CPU" aimed at starting a development activity to spin-in the SATA data storage technology to the space market.
Adoption of SATA provides a low cost solution, high data rates, easy integration due to the compact cabling and greater flexibility with respect to the system configuration.

In the last years, the SATA SSD storage technology has gained good penetration in the military and defense segments thanks to its relevant benefits over competitive solutions and to the technological trend in the industry and consumer markets.

The non volatile NAND-based flash memory, on which the SATA SSDs are based, is raising an increasing interest for space applications too. Research activities are on-going to define powerful error-correction system to mitigate the possible failure of those memories and allow them to be reliable over a long period of time.

Space applications could benefit from the adoption of the SATA protocol as interface layer between the host controller and the mass memory module. Currently no space-proven implementation of the SATA specification exists.

As first step, TSD has proposed the development of a LEON based CPU implementing the SATA controller in the same FPGA that hosts the LEON Soft IP core; such device could initially be used, in combination with ruggedized COTS SATA devices, for short missions and in general for missions with low radiation tolerance requirements.

In a subsequent step, in order to provide a complete radiation tolerant SATA storage solution, a solid state qualified storage device with SATA interface could be designed as a follow-up R&D activity. ESA has already on-going activities in this field to establish the use of NAND flash in space applications. The LEON based CPU has already been designed by adopting components available in radiation tolerant version, like the FPGA that is a commercial device that can be substituted by the space grade Virtex-5QV FPGA, the industry's first high performance rad-hard reconfigurable FPGA for processing-intensive space systems. So the CPU could be produced in space qualified version suitable for typical demanding applications, as well.

The integration of the SATA Controller into a Space CPU has been achieved with a module named CCSM (Control, Communication and Storage Module). The CCSM Mother-board is built around a complex System-On-Chip implemented in the Virtex-5 FPGA. It embeds the Leon3 CPU along with a set of standard peripherals, external data and program memories to store and run the operating system and application software.